

MINING ONLINE MUSIC LISTENING TRAJECTORIES

Flavio Figueiredo¹

Bruno Ribeiro²

Christos Faloutsos³

Nazareno Andrade⁴

Jussara M. Almeida⁵

¹ IBM Research - Brazil

² Purdue University

³ Carnegie Mellon University

⁴ Universidade Federal de Campina Grande

⁵ Universidade Federal de Minas Gerais

ABSTRACT

Understanding the listening habits of users is a valuable undertaking for musicology researchers, artists, consumers and online businesses alike. With the rise of Online Music Streaming Services (OMSSs), large amounts of user behavioral data can be exploited for this task. In this paper, we present SWIFT-FLOWS, an approach that models user listening habits in regards to how user attention transitions between artists. SWIFT-FLOWS combines recent advances in trajectory mining, coupled with modulated Markov models as a means to capture both how users switch attention from one artist to another, as well as how users fixate their attention in a single artist over short or large periods of time. We employ SWIFT-FLOWS on OMSSs datasets showing that it provides: (1) semantically meaningful representation of habits; (2) accurately models the attention span of users.

1. INTRODUCTION

Is it possible to create expressive yet succinct representations of individuals' music listening habits? Are there common patterns on how music is listened to across different genres and different artists that have highly different popularity? For a long time such questions have attracted the attention of researchers from different fields. In the fields of psychology and musicology [10, 20, 21], researchers exploit musical preferences to study social and individual identity [20], mood regulation [23], as well as the underlying factors of preferences [21]. Computer scientists are also tackling such questions as they become central to develop music recommender systems [3, 4, 7].

With the rise of Online Music Streaming Services (OMSSs) over the last decade, large datasets of user¹ behavior can be used to shed light on questions like the ones above. More specifically, digital traces of the listening habits of individuals are readily available to researchers.

¹ Since our case study is on Online Music Streaming Services (OMSSs), we use the terms users and listeners interchangeably.

In this paper, we focus on the online listening habits of users as trajectories [7] (or trails [24]). Given that a user, u , listens to music by switching attention between different artists, a trajectory captures the sequence of artists or songs visited by a user when listening to music. The main contribution of this paper is to present the SWIFT-FLOWS² model, a general technique designed to study user trajectories in OMSSs. We tackle several challenges that stem from the complexity of user behavior, such as:

- (a) *Asynchronous users with mixed but similar behavior*: Users that consume music from a set of artists will not start their playlists at the same time or listen to songs in the same order.
- (b) *Repeated consumption*: Users tend to listen to artists in bursts, more than what one would expect at random in a shuffled playlist.
- (c) *Biased Observations & Small Subpopulations*: User behavior datasets are naturally sparse and biased towards more popular artists. Nevertheless, we still want to be able to analyze underrepresented subpopulations of users and artists.

SWIFT-FLOWS effectiveness is evaluated in large datasets, with results showing that SWIFT-FLOWS: (1) captures semantically meaningful representation of artist transitions; (2) accurately models the attention span of users.

2. RELATED WORK

Understanding the listening habits of individuals has attracted interest from different research fields. Among other problems, musicologists and social psychologists have looked into the latent factors that explain musical preferences [20, 21], factors that affect listener experience (e.g., Music itself, Situational Factors and the Listener him/herself) [10], as well as the relationships between musical imagination and human creativity [10].

Regarding the material methods listeners exploit to listen to music, Nowak [16] discussed the social-material relations of music consumption. The authors conclude that even the same user still relies on multiple forms of listening to music (e.g., legal and illegal downloading, streaming services, CDs, etc). These various forms of consumption were also discussed by Bellogin *et al.* [1]. Here, the au-

² Switch and Fixation Trajectory Flows

